AmsterdamUMCdb

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Amsterdam UMC

Center for Critical Care Computational Intelligence

Disclosures

- European Commission
- Zorgverzekeraars Nederland
- ZonMw
- Lage Landen
- ICUdata
- ESICM
- International Fluid Academy
- Fisher & Paykel
- GE Healthcare
- Mindray
- Pacmed
- Werfen
- Strive Health

For many daily clinical questions at the bedside high quality evidence is lacking

The promise of machine learning in medicine

The wisdom contained
in the **decisions made by nearly all clinicians**
and the **outcomes of billions of patients**
should inform the care of each patient

Rajkomar NEJM 2019

The ICU is a natural habitat for AI/ML

- Lots of data
- High mortality
- Uncertainty on diagnosis and prognosis
- Decisions with consequences

we have a problem

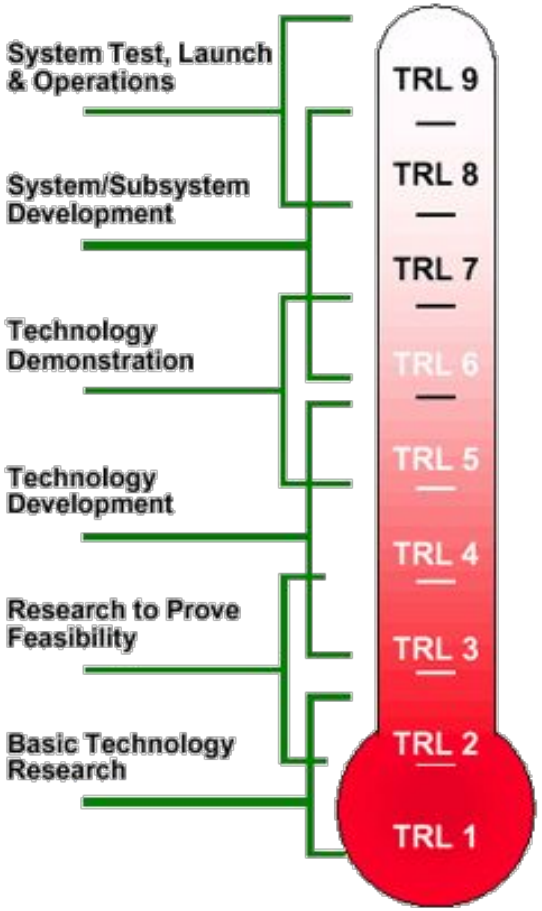
> Intensive Care Med. 2020 Jul;46(7):1486-1488. doi: 10.1007/s00134-020-06045-y. Epub 2020 May 12.

Machine learning in intensive care medicine: ready for take-off?

Lucas M Fleuren [1 2], Patrick Thoral [3], Duncan Shillan [4], Ari Ercole [5 6], Paul W G Elbers [3 6]; Right Data Right Now Collaborators

Collaborators, Affiliations + expand

PMID: 32399747 DOI: 10.1007/s00134-020-06045-y



9. Model integration
8. Clinical outcome evaluation
7. Workflow implementation
6. Real-time model testing
5. Model validation
4. Model development
3. Model prototyping
2. Proposal of model/solution
1. Clinical problem identification

> Intensive Care Med. 2021 Jul;47(7):750-760. doi: 10.1007/s00134-021-06446-7.
Epub 2021 Jun 5.

Moving from bytes to bedside: a systematic review on the use of artificial intelligence in the intensive care unit

Davy van de Sande [1], Michel E van Genderen [2], Joost Huiskens [3], Diederik Gommers [1], Jasper van Bommel [1]

Affiliations + expand

PMID: 34089064 PMCID: PMC8178026 DOI: 10.1007/s00134-021-06446-7

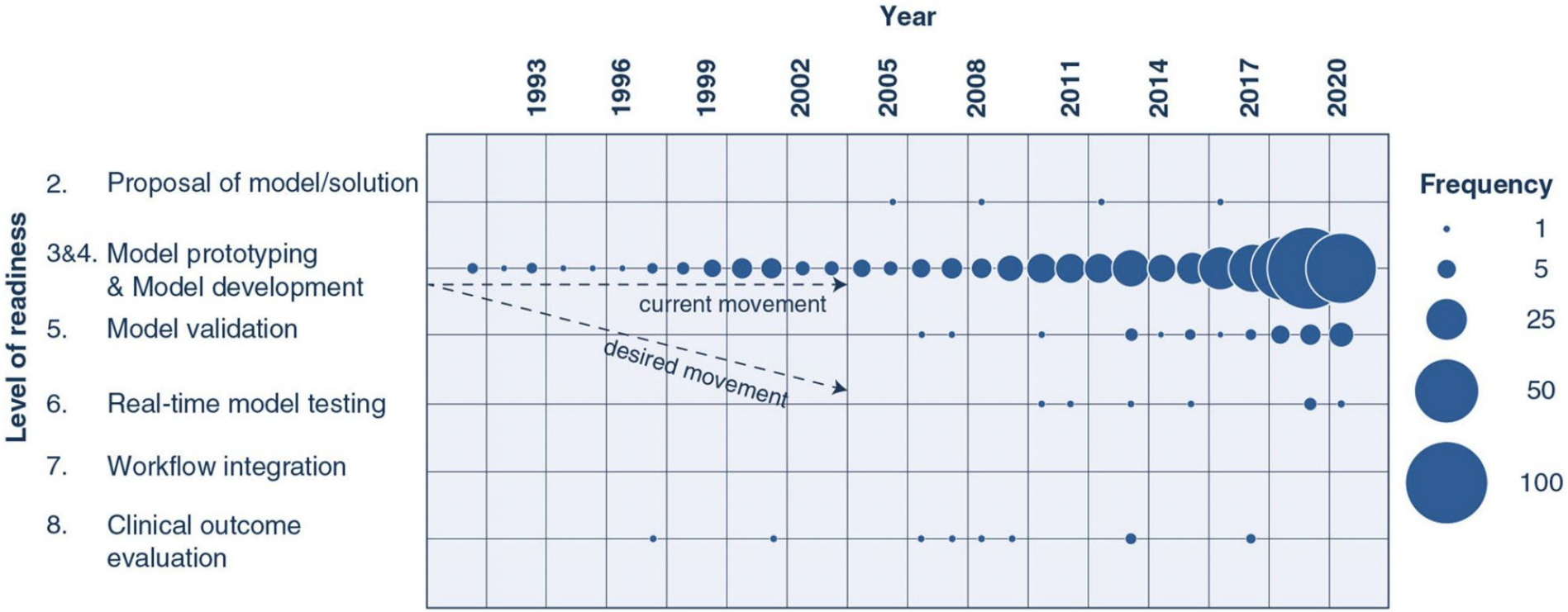


Fig. 3 Number of studies published according to their level of readiness and year of publication. The total number of studies reporting on model development and prototyping (level 3 and 4), increased rapidly from 30 studies per year in 2017 to 92 studies per year in 2019. Furthermore, the number of studies per year reporting on external validation (level 5) increased from two in 2017 to seven in 2019. The current movement is mainly horizontal whereas the desired movement is diagonal, i.e. towards clinical evaluation

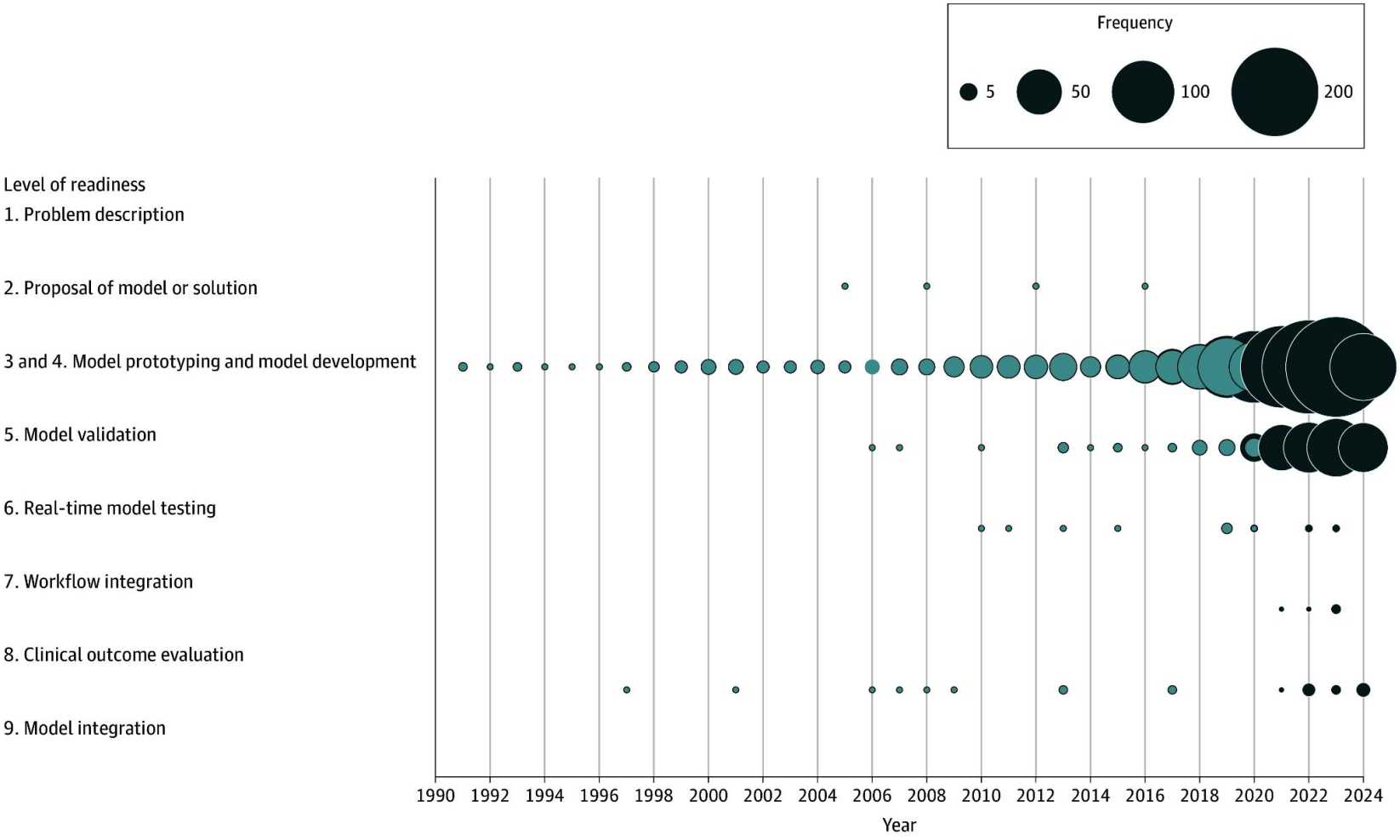
> JAMA Netw Open. 2025 Jul 1;8(7):e2522866. doi: 10.1001/jamanetworkopen.2025.22866.

Operationalization of Artificial Intelligence Applications in the Intensive Care Unit: A Systematic Review

Willemijn E M Berkhout [1 2], Julia J van Wijngaarden [1 2 3], Jessica D Workum [1 2 4], Davy van de Sande [1 2], Denise E Hilling [2 5], Christian Jung [6 7], Geert Meyfroidt [8 9], Diederik Gommers [1 2], Stefan N R Buijsman [10], Michel E van Genderen [1 2]

Affiliations + expand

PMID: 40699572 PMCID: PMC12287835 DOI: 10.1001/jamanetworkopen.2025.22866


Frequency
5
50
100
200
Level of readiness
1. Problem description
2. Proposal of model or solution
3 and 4. Model prototyping and model development
5. Model validation
6. Real-time model testing
7. Workflow integration
8. Clinical outcome evaluation
9. Model integration
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
Year

Barriers

- Lack of data availability
  - Legislation, competition
- Lack of implementation
  - Legislation, security
- Lack of understanding
  - Doctors are no data scientists and vice versa

Major barrier: lack of data sharing

Elephants

- Clinicians/researchers perceive data as
  - Their property
    - to remain leader in the field?

- Hospitals perceive data as
  - Source of revenue?
  - Claim to fame?
  - Risk of uncovering suboptimal practice?

All intensivists learn from every single patient they treat

So, is there such a thing as patient data ownership?

Healthcare Solidarity = Data Solidarity

Sharing is caring

- AmsterdamUMCdb – 1 center – Amsterdam, The Netherlands
- HIRID – 1 center – Bern, Switzerland
- MIMIC – 1 center – USA
- Northwestern ICU - 1 center - USA
- SICdb – 1 center – Salzburg, Austria
- MIMIC-Brazil - 1 center - Brazil

- K-MIMIC - 10 centers - Korea
- eICU - many centers - USA
- CLIF consortium - federated - USA
- INDICATE - 15+ centers - federated - EU
- ICUdata4EU - 18+ centers - federated - EU
- CRITICAL - 4 centers - USA
- ICUdata.nl - 12 centers - NL

> Crit Care Med. 2022 Jun 1;50(6):e581-e588. doi: 10.1097/CCM.0000000000005517. Epub 2022 Mar 2.

Systematic Review and Comparison of Publicly Available ICU Data Sets-A Decision Guide for Clinicians and Data Scientists

Christopher M Sauer [1 2], Tariq A Dam [1], Leo A Celi [1 2 3 4 5 6 7 8], Martin Faltys [5], Miguel A A de la Hoz [2 3 6], Lasith Adhikari [7], Kirsten A Ziesemer [8], Armand Girbes [1], Patrick J Thoral [1], Paul Elbers [1]

Affiliations + expand

PMID: 35234175 PMCID: PMC9150442 DOI: 10.1097/CCM.0000000000005517

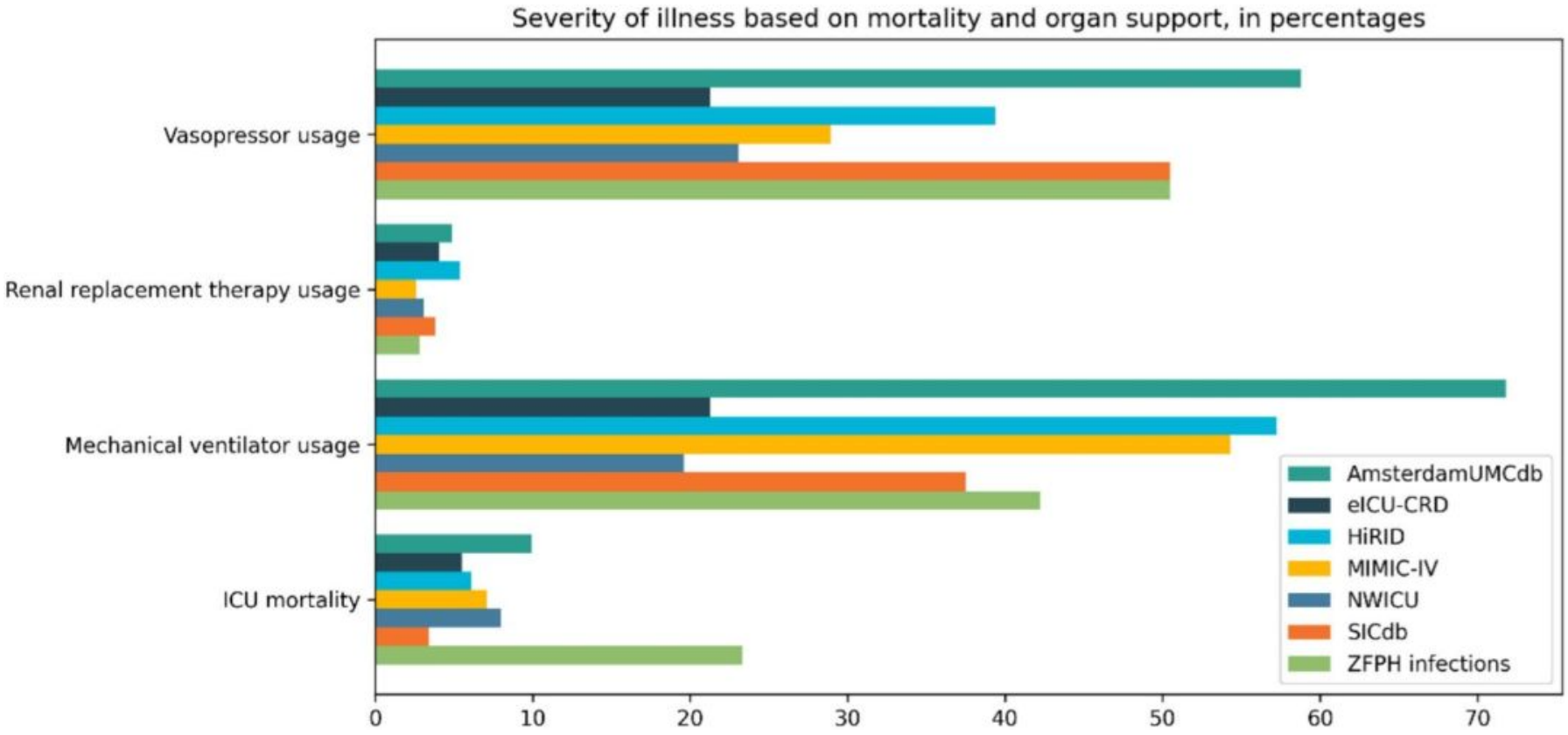
J Crit Care. 2025 Dec:90:155205. doi: 10.1016/j.jcrc.2025.155205. Epub 2025 Aug 6.

Sharing is caring: A systematic review of publicly available intensive care data sets

A R Jagesar [1], T A Dam [2], T Struja [3], C M Sauer [4], M Otten [2], L A Biesheuvel [2], A R J Girbes [5], L Adhikari [6], Z Zhang [7], M Faltys [8], N Rodemund [9], P J Thoral [5], L A Celi [10], P W G Elbers [5]

Affiliations + expand

PMID: 40768939 DOI: 10.1016/j.jcrc.2025.155205


Severity of illness based on mortality and organ support, in percentages
Vasopressor usage
Renal replacement therapy usage
Mechanical ventilator usage
ICU mortality
AmsterdamUMCdb
eICU-CRD
HiRID
MIMIC-IV
NWICU
SICdb
ZFPH infections
0
10
20
30
40
50
60
70

AmsterdamUMCdb

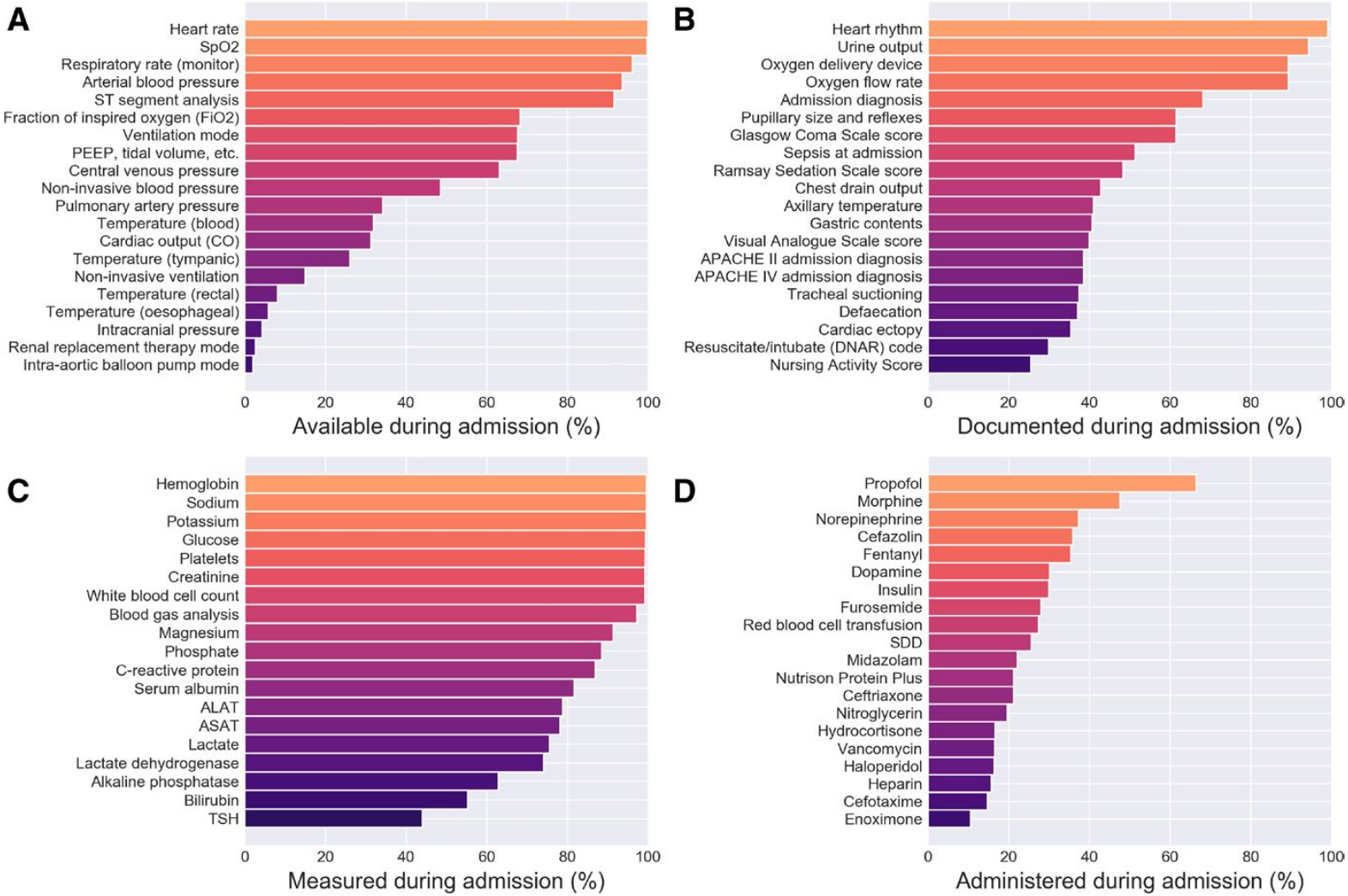
> Crit Care Med. 2021 Jun 1;49(6):e563-e577. doi: 10.1097/CCM.0000000000004916.

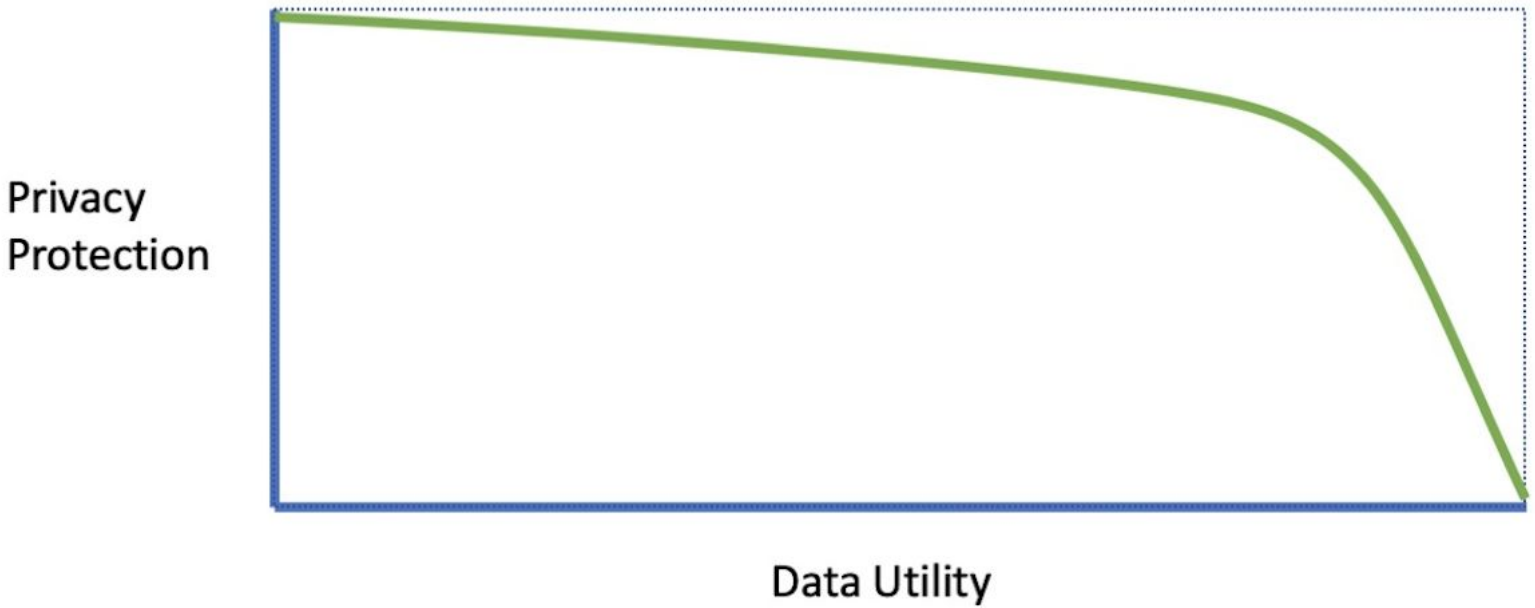
Sharing ICU Patient Data Responsibly Under the Society of Critical Care Medicine/European Society of Intensive Care Medicine Joint Data Science Collaboration: The Amsterdam University Medical Centers Database (AmsterdamUMCdb) Example

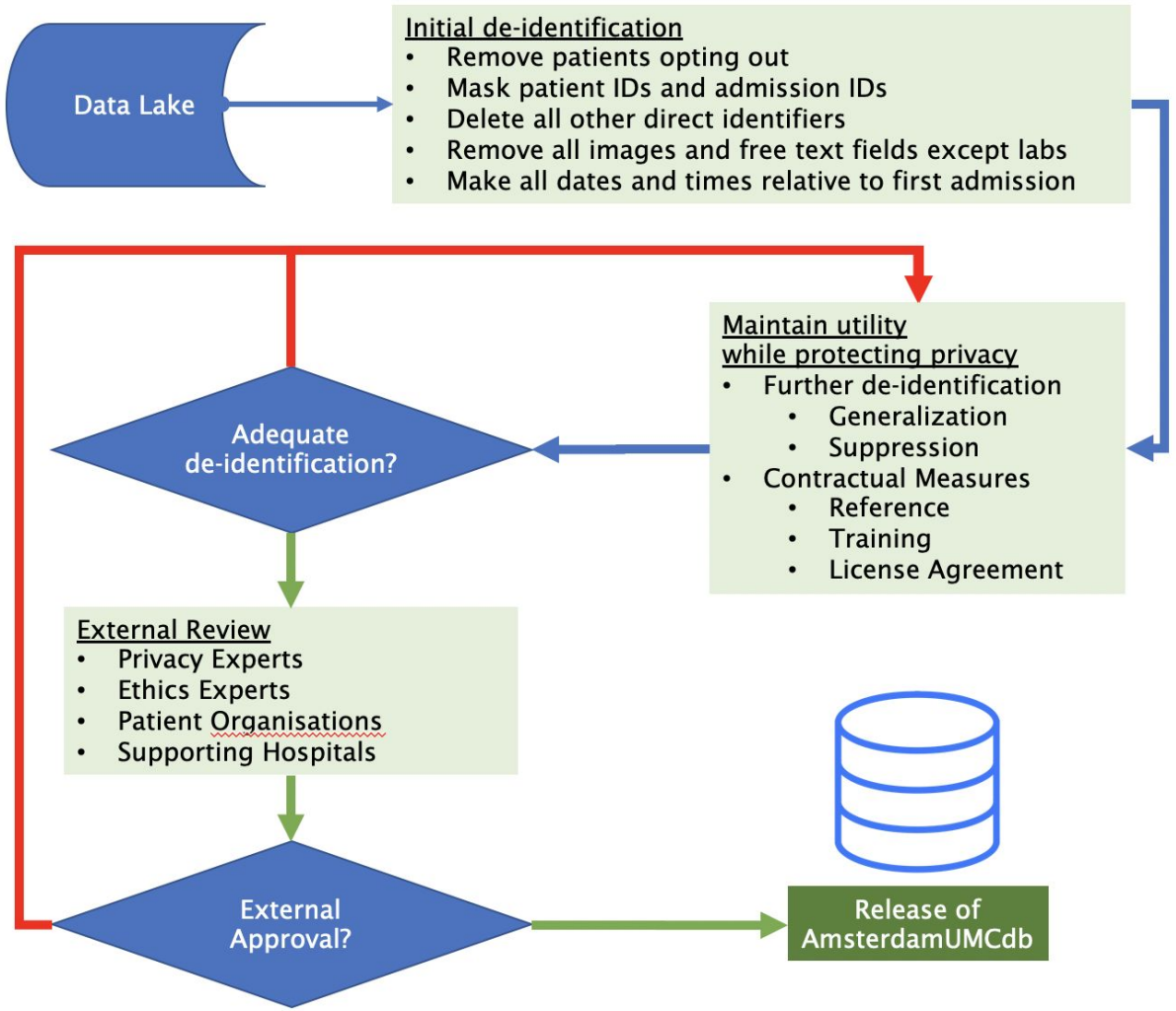
Patrick J Thoral [1], Jan M Peppink [1], Ronald H Driessen [1], Eric J G Sijbrands [2], Erwin J O Kompanje [3], Lewis Kaplan [4 5], Heatherlee Bailey [6 5], Jozef Kesecioglu [7 8], Maurizio Cecconi [8 9], Matthew Churpek [10], Gilles Clermont [11], Mihaela van der Schaar [12 13], Ari Ercole [14 15], Armand R J Girbes [1 8], Paul W G Elbers [1 15], Amsterdam University Medical Centers Database (AmsterdamUMCdb) Collaborators and the SCCM/ESICM Joint Data Science Task Force

Affiliations + expand

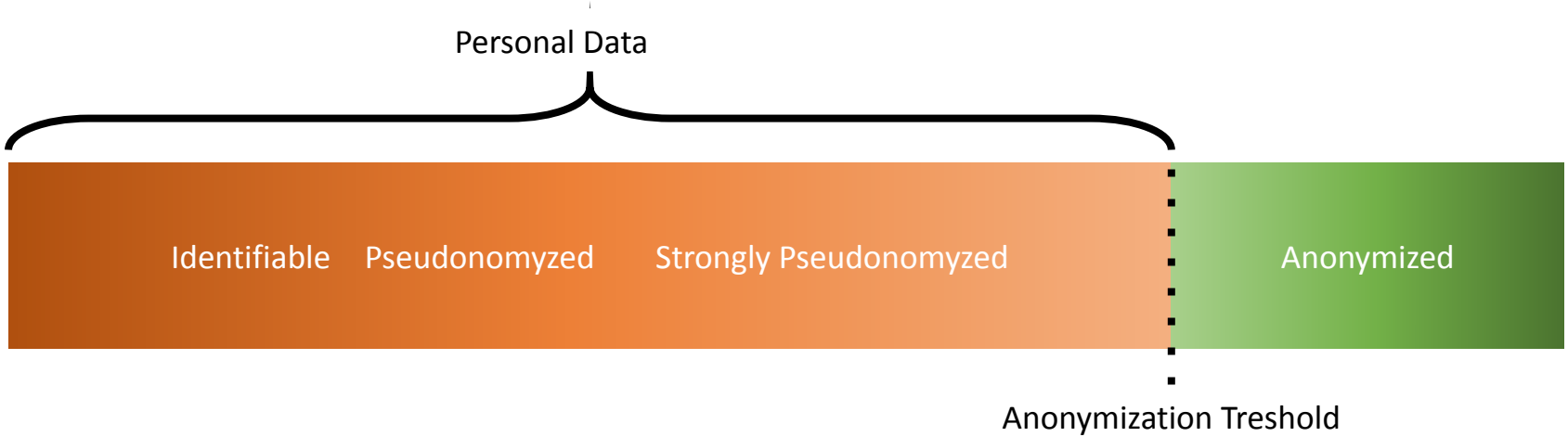
PMID: 33625129 PMCID: PMC8132908 DOI: 10.1097/CCM.0000000000004916

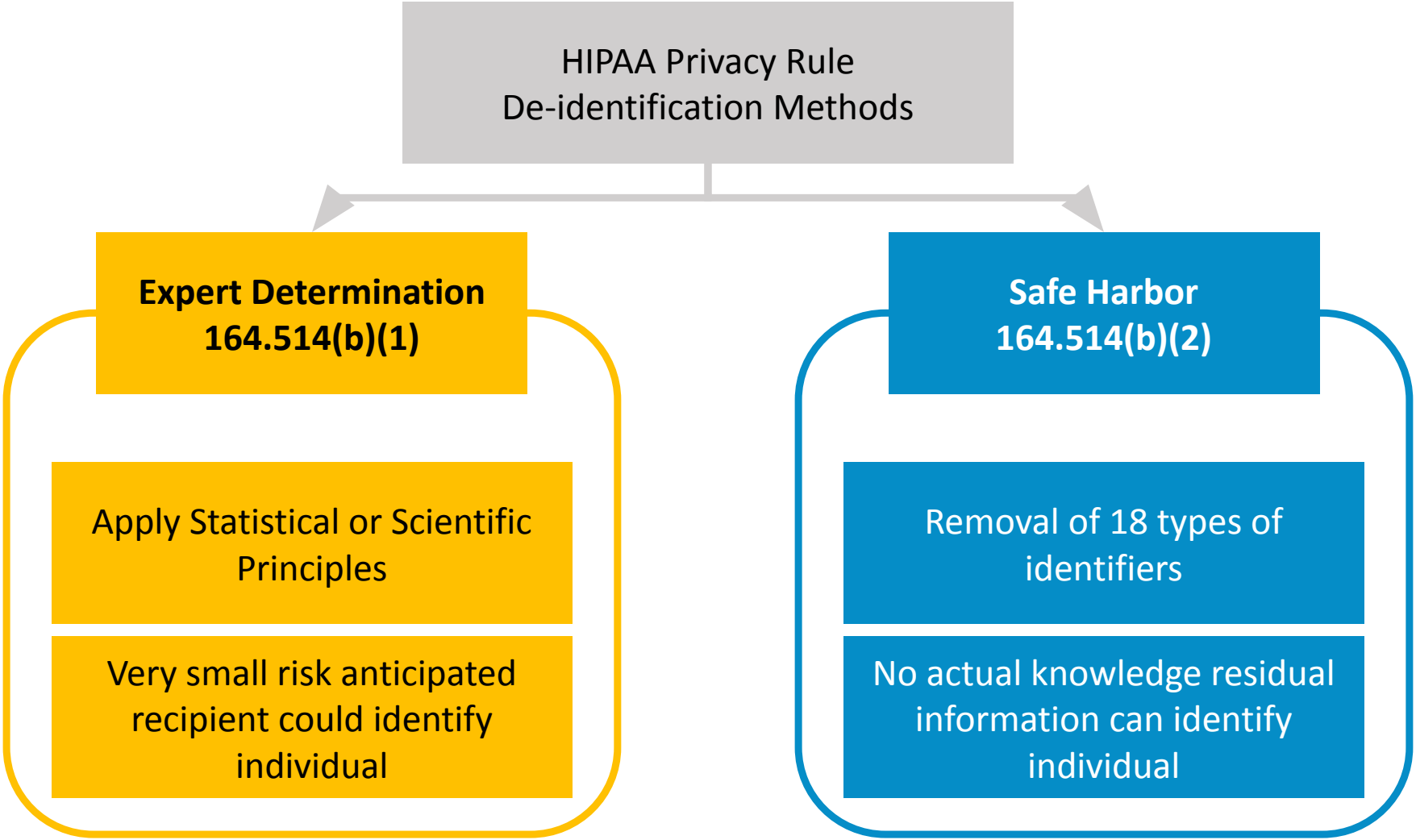

A
Heart rate
SpO2
Respiratory rate (monitor)
Arterial blood pressure
ST segment analysis
Fraction of inspired oxygen (FiO2)
Ventilation mode
PEEP, tidal volume, etc.
Central venous pressure
Non-invasive blood pressure
Pulmonary artery pressure
Temperature (blood)
Cardiac output (CO)
Temperature (tympanic)
Non-invasive ventilation
Temperature (rectal)
Temperature (oesophageal)
Intracranial pressure
Renal replacement therapy mode
Intra-aortic balloon pump mode
0 20 40 60 80 100
Available during admission (%)
B
Heart rhythm
Urine output
Oxygen delivery device
Oxygen flow rate
Admission diagnosis
Pupillary size and reflexes
Glasgow Coma Scale score
Sepsis at admission
Ramsay Sedation Scale score
Chest drain output
Axillary temperature
Gastric contents
Visual Analogue Scale score
APACHE II admission diagnosis
APACHE IV admission diagnosis
Tracheal suctioning
Defaecation
Cardiac ectopy
Resuscitate/intubate (DNAR) code
Nursing Activity Score
0 20 40 60 80 100
Documented during admission (%)
C
Hemoglobin
Sodium
Potassium
Glucose
Platelets
Creatinine
White blood cell count
Blood gas analysis
Magnesium
Phosphate
C-reactive protein
Serum albumin
ALAT
ASAT
Lactate
Lactate dehydrogenase
Alkaline phosphatase
Bilirubin
TSH
0 20 40 60 80 100
Measured during admission (%)
D
Propofol
Morphine
Norepinephrine
Cefazolin
Fentanyl
Dopamine
Insulin
Furosemide
Red blood cell transfusion
SDD
Midazolam
Nutrison Protein Plus
Ceftriaxone
Nitroglycerin
Hydrocortisone
Vancomycin
Haloperidol
Heparin
Cefotaxime
Enoximone
0 20 40 60 80 100
Administered during admission (%)


Privacy
Protection
Data Utility


Data Lake
Initial de-identification
• Remove patients opting out
• Mask patient IDs and admission IDs
• Delete all other direct identifiers
• Remove all images and free text fields except labs
• Make all dates and times relative to first admission
Maintain utility
while protecting privacy
• Further de-identification
• Generalization
• Suppression
• Contractual Measures
• Reference
• Training
• License Agreement
Adequate
de-identification?
External Review
• Privacy Experts
• Ethics Experts
• Patient Organisations
• Supporting Hospitals
External
Approval?
Release of
AmsterdamUMCdb

re-identification not reasonably likely


Personal Data
Identifiable
Pseudonomyzed
Strongly Pseudonomyzed
Anonymized
Anonymization Treshold


HIPAA Privacy Rule
De-identification Methods
Expert Determination
164.514(b)(1)
Apply Statistical or Scientific Principles
Very small risk anticipated recipient could identify individual
Safe Harbor
164.514(b)(2)
Removal of 18 types of identifiers
No actual knowledge residual information can identify individual

Governance

- End user license agreement
  - requires the signature of a practicing intensivist
  - training on data integrity
- Opt-out procedure
- Audits
  - Patient organizations
  - External experts on ethics and privacy
  - Supporting hospitals
- Controlled access protocol for source data
- Education and delegation logs
- Continuous quality control cycle

Access Request Form and End User License Agreement for AmsterdamUMCdb

Please fill out and sign this form to request access to AmsterdamUMCdb both for yourself, the main applicant, and for your reference. Your reference should be a practicing intensivist, easily identifiable as such through an online directory, institutional web page or an equivalent source. Both you and your reference should sign this form, agree with the terms of the End User License on this form and share the associated responsibilities.

By signing this form, we formally request access to AmsterdamUMCdb and we formally accept the terms of the End User License on this form		
Intended use		
	About you, the main applicant	**About your reference**
Full name		
Affiliation		
Institutional E-mail		
Date		
Place		
Signature		

Terms of the End User License Agreement

1. We will only share access to AmsterdamUMCdb or any part thereof with those whose access request form has also been approved by the administrators of AmsterdamUMCdb and not with anyone else and only after specific additional approval by e-mail by the administrators of AmsterdamUMCdb.
2. We will only use AmsterdamUMCdb and any results from using AmsterdamUMCdb for lawful, non-commercial, scientific research purposes.
3. We will avoid any attempt to re-identify anyone or anything in AmsterdamUMCdb.
4. We will avoid any disclosure of the identity of anyone or anything in AmsterdamUMCdb.
5. We will immediately notify the administrators of AmsterdamUMCdb if we suspect that anyone other than us has gained access to AmsterdamUMCdb or if we suspect that there is any possibility to re-identify anyone or anything in AmsterdamUMCdb and report on this in such detail that allows for corrective action.
6. We will deposit all code we write to interact with AmsterdamUMCdb to the AmsterdamUMCdb GitHub repository.
7. We will actively attempt to involve intensive care professionals of Amsterdam UMC in our projects related to AmsterdamUMCdb to provide domain expertise and academic guidance and we will request them to participate as co-authors on our publications related to AmsterdamUMCdb, in which we will also appropriately reference AmsterdamUMCdb.
8. We agree that the Foundation VUmc, the legal entity of one of the hospitals of Amsterdam UMC, will store our personal data on this form for administrative purposes, for analytical purposes and to publish these personal data and the results of those analyses online.
9. We confirm that the main applicant has completed the DSOR course from CITI, the BROK course from NFU or an equivalent course and we have attached proof.
10. We confirm that the reference of the main applicant is a practicing intensivist who is willing to assist the main applicant by providing domain expertise.
11. We acknowledge that our obligations with respect to AmsterdamUMCdb shall also continue after termination of this agreement for any reason.
12. We agree that if we fail to meet any of the aforementioned terms, we will immediately be required to pay to Foundation VUmc, the legal entity of one of the hospitals of Amsterdam UMC, either the sum of ten thousand euros and an additional one thousand euros for every day such failure continues, or the real value of damages, lost profit and potential lost profit incurred by such failure, whichever amount is higher.

Hypothetical Plausible Adversaries

‘friendly researcher’
might inadvertently re-identify an acquaintance

‘rogue researcher’
might deliberately re-identify someone
using public information

‘rogue insurance company’
might seek, albeit illegally, to re-identify someone
using the company database

$$P(\text{re-id}) = P(\text{access}) * P(\text{intention}) * P(\text{re-id} \mid \text{public})$$

Chance or risk			Average risk based			Maximum risk based			
Adversary	**P(access)**	**P(intention)**	**P(re-id)**	***k*-anonymity**	***l*-diversity**	**P(re-id)**	***k*-anonymity**	***l*-diversity**	**P(final risk)**
Friendly Researcher	1.00	0.20*	0.046	89	26	0.50	2	2	0.01 †
Rogue Researcher	1.00	0.10	0.046	89	26	0.50	2	2	0.05 ‡
Rogue Insurance Company	0.27	0.10	**0.010**	619	69	0.50	2	2	0.0003 †

* acquaintance risk, the risk of knowing somebody in the database. † using strict average risk. ‡ using maximum risk.

Joint press release by

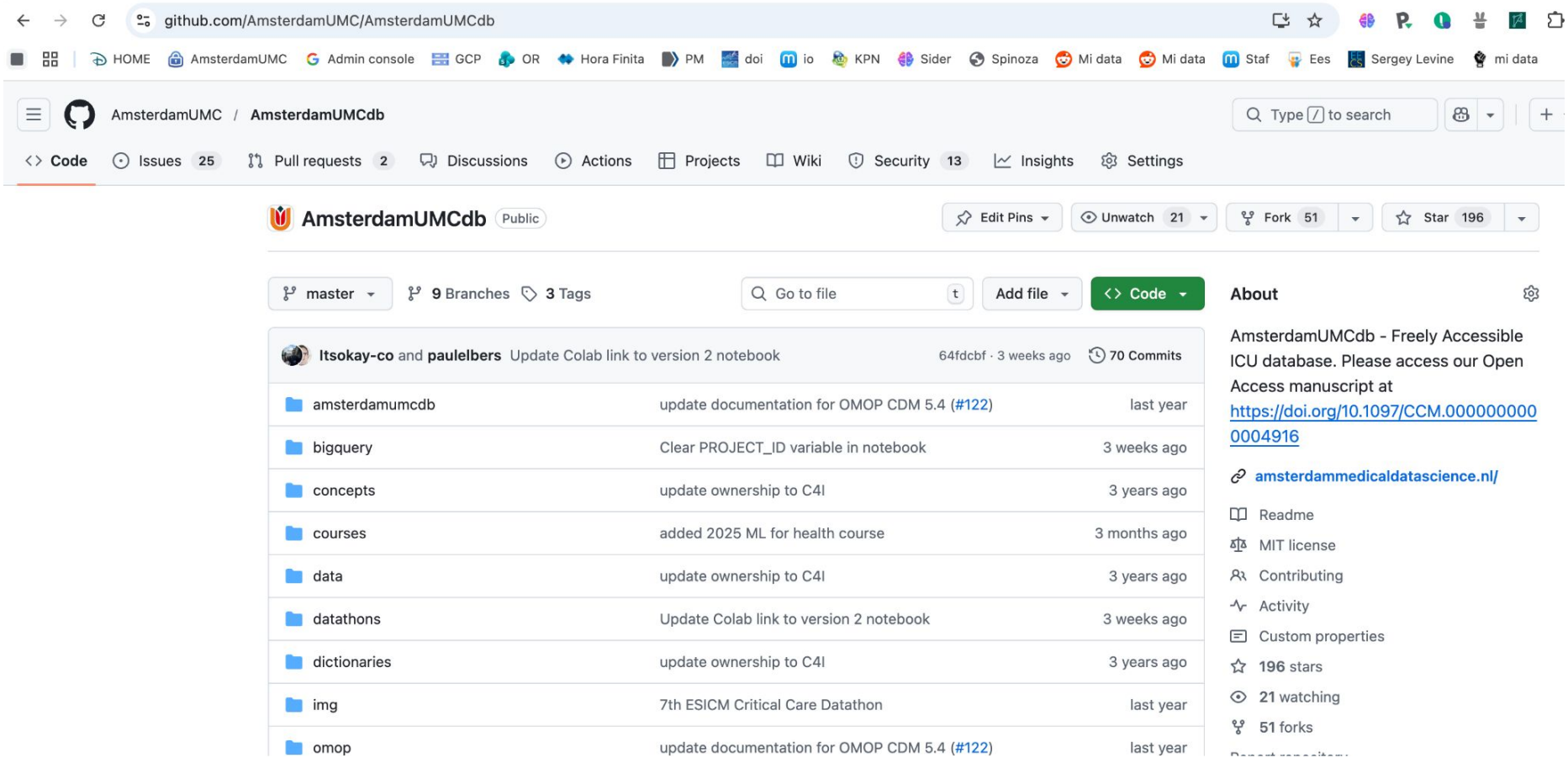
- Amsterdam UMC
- The European Society for Intensive Care Medicine (ESICM)
- The Dutch Society for Intensive Care Medicine (NVIC)

Amsterdam UMC makes data about intensive care patients available to save lives

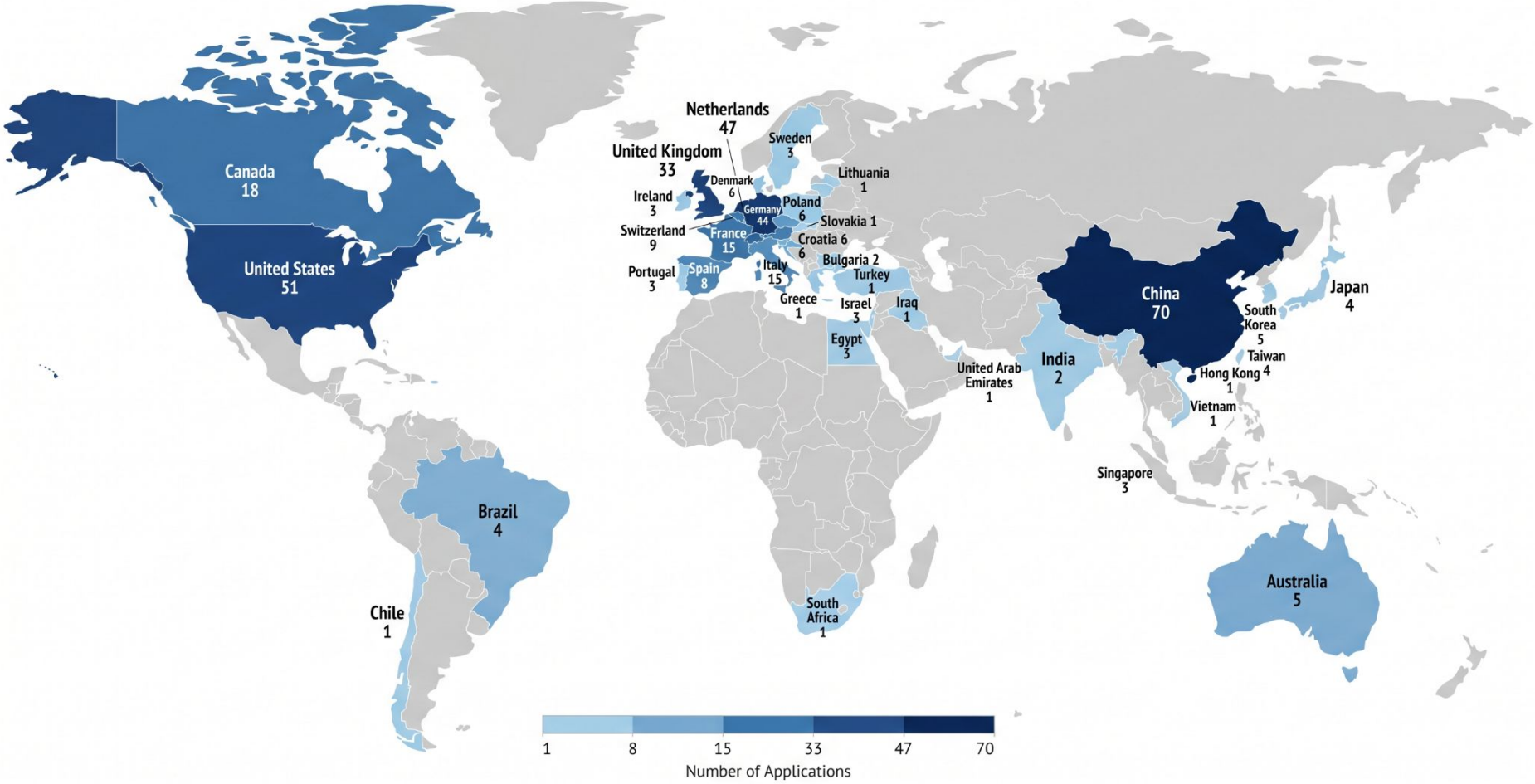

NOS
npo
medicatie
Amsterdam UMC
Paul Elbers
intensivist Amsterdam UMC

Privacy Audit:
data qualify as anonymous
in the context of the GDPR

Ethics Audit:
the principle of duty of easy rescue applies


github.com/AmsterdamUMC/AmsterdamUMCdb
HOME
AmsterdamUMC
Admin console
GCP
OR
Hora Finita
PM
doi
io
KPN
Sider
Spinoza
Mi data
Mi data
Staf
Ees
Sergey Levine
mi data
AmsterdamUMC / AmsterdamUMCdb
Type / to search
Code
Issues 25
Pull requests 2
Discussions
Actions
Projects
Wiki
Security 13
Insights
Settings
AmsterdamUMCdb Public
Edit Pins
Unwatch 21
Fork 51
Star 196
master
9 Branches
3 Tags
Go to file t
Add file
Code
Itsokay-co and paulelbers Update Colab link to version 2 notebook
64fdcbf · 3 weeks ago
70 Commits
amsterdamumcdb update documentation for OMOP CDM 5.4 (#122) last year
bigquery Clear PROJECT_ID variable in notebook 3 weeks ago
concepts update ownership to C4I 3 years ago
courses added 2025 ML for health course 3 months ago
data update ownership to C4I 3 years ago
datathons Update Colab link to version 2 notebook 3 weeks ago
dictionaries update ownership to C4I 3 years ago
img 7th ESICM Critical Care Datathon last year
omop update documentation for OMOP CDM 5.4 (#122) last year
About
AmsterdamUMCdb - Freely Accessible ICU database. Please access our Open Access manuscript at https://doi.org/10.1097/CCM.0000000000004916
amsterdammedicaldatascience.nl/
Readme
MIT license
Contributing
Activity
Custom properties
196 stars
21 watching
51 forks

Applications per Country - Total: 404



Data Science Section_


DATATHON
2026

Editorial > Intensive Care Med Exp. 2024 Mar 12;12(1):29. doi: 10.1186/s40635-024-00615-w.

The ESICM datathon and the ESICM and ICMx data science strategy

Paul Elbers [1], Patrick Thoral [1], Lieuwe D J Bos [2], Massimiliano Greco [3], Pedro D Wendel-Garcia [4], Ari Ercole [5]

Affiliations + expand

PMID: 38472595 PMCID: PMC10933238 DOI: 10.1186/s40635-024-00615-w

1 Cite

NutriSighT: Interpretable Transformer Model for Dynamic Prediction of Underfeeding Enteral Nutrition in Mechanically Ventilated Patients.

Jangda M, Patel J, Vaid A, Gill J, McCarthy P, Desman J, Gupta R, Patel D, Kavi N, Bakare S, Klang E, Freeman R, Manasia A, Oropello J, Chan L, Suarez-Farinas M, Charney AW, Kohli-Seth R, Nadkarni GN, Sakhuja A.

Nat Commun. 2025 Dec 17;16(1):11189. doi: 10.1038/s41467-025-66200-1.

PMID: 41408053 **Free PMC article.**

2 Cite

Sharing is caring: A systematic review of publicly available intensive care data sets.

Jagesar AR, Dam TA, Struja T, Sauer CM, Otten M, Biesheuvel LA, Girbes ARJ, Adhikari L, Zhang Z, Faltys M, Rodemund N, Thoral PJ, Celi LA, Elbers PWG.

J Crit Care. 2025 Dec;90:155205. doi: 10.1016/j.jcrc.2025.155205. Epub 2025 Aug 6.

PMID: 40768939 **Free article.**

3 Cite

Development and validation of a machine learning model for real-time prediction of invasive mechanical ventilation weaning readiness.

Zappalà S, Scaravilli V, Rovati L, Bosone M, Alfieri F, Ancona A, Grasselli G.

J Crit Care. 2025 Oct;89:155105. doi: 10.1016/j.jcrc.2025.155105. Epub 2025 May 27.

PMID: 40435812 **Free article.**

4 Cite

Elucidating the causal relationship of mechanical power and lung injury: a dynamic approach to ventilator management.

Wu C, Canakoglu A, Vine J, Mathur A, Nath R, Kashiouris M, Mathur P, Ercole A, Elbers P, Duggal A, Wong KK, Bhattacharyya A.

Intensive Care Med Exp. 2025 Feb 28;13(1):28. doi: 10.1186/s40635-025-00736-w.

PMID: 40019703 **Free PMC article.**

5 Cite

Optimizing mechanical ventilation: Personalizing mechanical power to reduce ICU mortality - a retrospective cohort study.

Alkhalifah AS, Rumindo K, Brincat E, Blanchard F, Helleberg J, Clarke D, Popoff B, Duranteau O, Mohamed ZU, Senosy A.

PLoS One. 2025 Feb 13;20(2):e0318018. doi: 10.1371/journal.pone.0318018. eCollection 2025.

PMID: 39946423 **Free PMC article.**

6 Cite

NutriSighT: Interpretable Transformer Model for Dynamic Prediction of Hypocaloric Enteral Nutrition in Mechanically Ventilated Patients.

Jangda M, Patel J, Gill J, McCarthy P, Desman J, Gupta R, Patel D, Kavi N, Bakare S, Klang E, Freeman R, Manasia A, Oropello J, Chan L, Suarez-Farinas M, Charney AW, Kohli-Seth R, Nadkarni GN, Sakhuja A.

medRxiv [Preprint]. 2025 Jan 6:2025.01.06.25320067. doi: 10.1101/2025.01.06.25320067.

Update in: Nat Commun. 2025 Dec 17;16(1):11189. doi: 10.1038/s41467-025-66200-1.

PMID: 39830234 **Free PMC article.** Preprint.

7 Cite

Predictive performance of ROX index and its variations for NIV failure.

Lijović L, Radočaj T, Kovač N, Vučić M, Elbers P.

Med Intensiva (Engl Ed). 2025 Jul;49(7):502136. doi: 10.1016/j.medine.2025.502136. Epub 2025 Jan 13.

PMID: 39809650 **Free article.**

8 Cite

Contribution of Open Access Databases to Intensive Care Medicine Research: Scoping Review.

Kallout J, Lamer A, Grosjean J, Kerdelhué G, Bouzillé G, Clavier T, Popoff B.

J Med Internet Res. 2025 Jan 9;27:e57263. doi: 10.2196/57263.

PMID: 39787600 **Free PMC article.**

9 Cite

Predicting blood transfusion demand in intensive care patients after surgery by comparative analysis of temporally extended data selection.

Sheikhalishahi S, Goss S, Seidlmayer LK, Zaghdoudi S, Hinske LC, Kaspar M.

BMC Med Inform Decis Mak. 2024 Dec 18;24(1):397. doi: 10.1186/s12911-024-02800-z.

PMID: 39695617 **Free PMC article.**

10 Cite

SepsisLab: Early Sepsis Prediction with Uncertainty Quantification and Active Sensing.

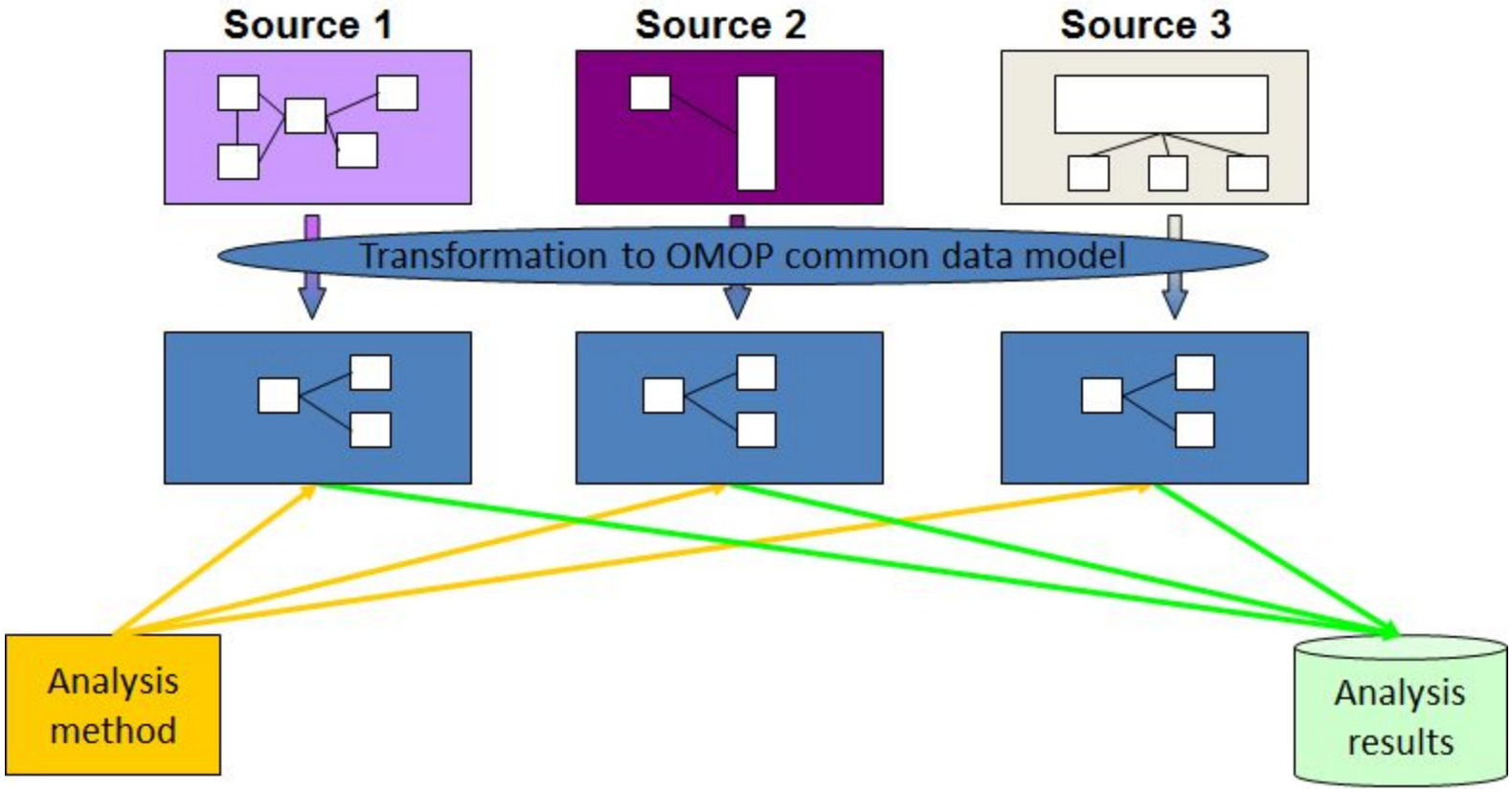
Yin C, Chen PY, Yao B, Wang D, Caterino J, Zhang P.

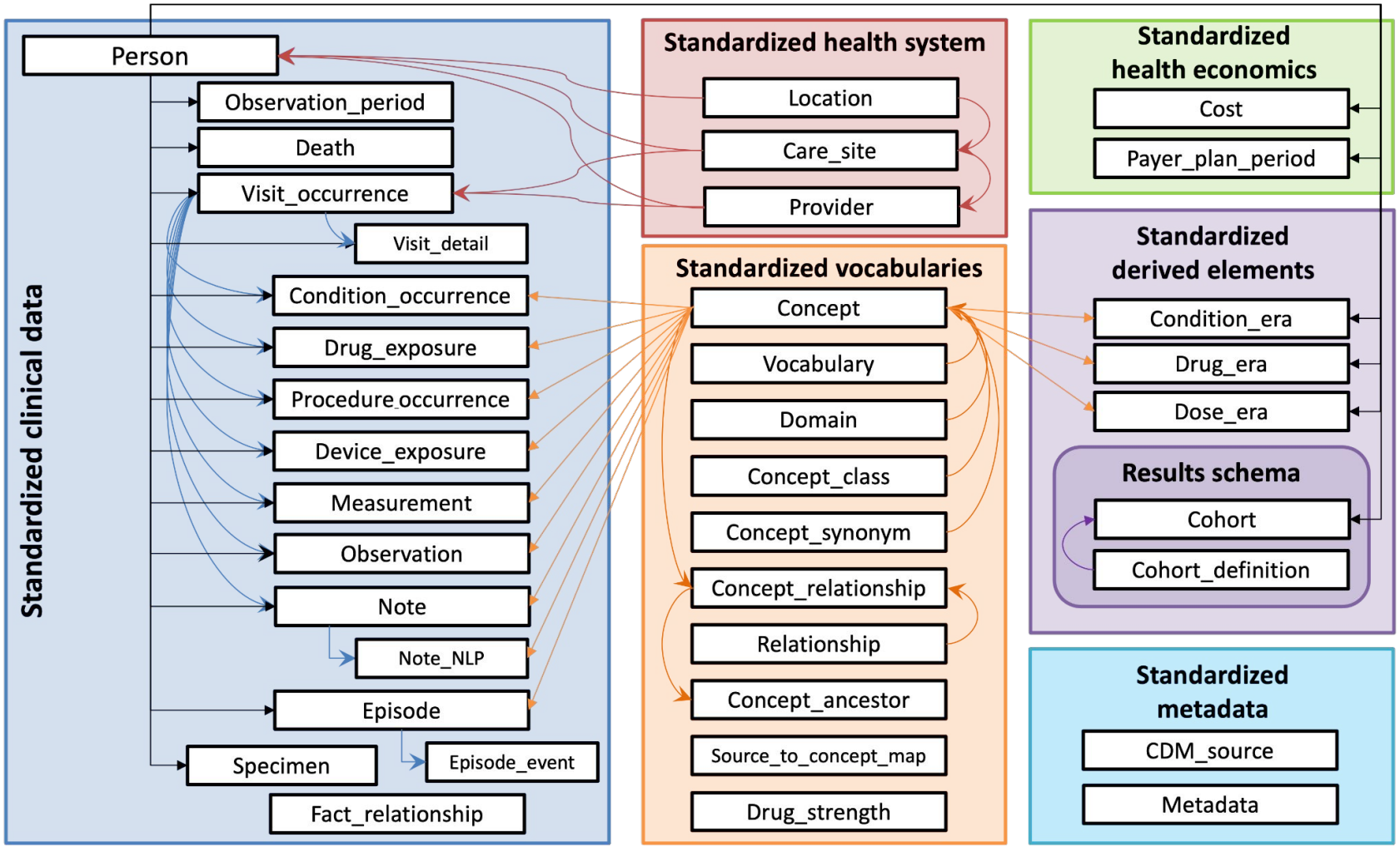
KDD. 2024 Aug;2024:6158-6168. doi: 10.1145/3637528.3671586. Epub 2024 Aug 24.

PMID: 39399376 **Free PMC article.**

Standardized Data: The OMOP Common Data Model

The Observational Medical Outcomes Partnership (OMOP) Common Data Model (CDM)
is an **open community data standard**,
designed to **standardize** the **structure** and **content** of observational data


Source 1
Source 2
Source 3
Transformation to OMOP common data model
Analysis method
Analysis results


Standardized clinical data
Person
Observation_period
Death
Visit_occurrence
Visit_detail
Condition_occurrence
Drug_exposure
Procedure_occurrence
Device_exposure
Measurement
Observation
Note
Note_NLP
Episode
Episode_event
Specimen
Fact_relationship
Standardized health system
Location
Care_site
Provider
Standardized vocabularies
Concept
Vocabulary
Domain
Concept_class
Concept_synonym
Concept_relationship
Relationship
Concept_ancestor
Source_to_concept_map
Drug_strength
Standardized health economics
Cost
Payer_plan_period
Standardized derived elements
Condition_era
Drug_era
Dose_era
Results schema
Cohort
Cohort_definition
Standardized metadata
CDM_source
Metadata

AmsterdamUMCdb

2026 Van Gogh OMOP

AmsterdamUMCdb Van Gogh 2026.01 OMOP

- Supported by Amsterdam UMC Innovation Grant
- Endorsed by ESICM and NVIC
- Multiple sources
  - VUmc MetaVision, AMC MetaVision, Amsterdam UMC Epic
  - Alignment with ICUdata project
  - Includes data collected for NICE registry
- Extensive stakeholder involvement

- Largest freely available high-granular GDPR compliant intensive care database worldwide
  - 78k admissions, 65k patients, 2003-2023
- Staged release strategy
  - Soft release during the 8th ESICM Critical Care Datathon
  - Final release expected in 2026

- Future
  - Waveforms?
  - Free text?

Wish list

- Cleaner and more inviting interface
- Custom forms and license
- Automatic social verification
- Automatic approval of cloud access to the data source
- Better dashboards